NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

IRRIGATION SYSTEM, SPRINKLER

(No. and Acre)

Code 442

DEFINITION

A planned irrigation system in which all necessary facilities are installed for efficiently applying water by means of perforated pipes or nozzles operated under pressure.

PURPOSE

The purpose of this practice is to efficiently and uniformly apply irrigation water to maintain adequate soil moisture for optimum plant growth without causing excessive water loss, erosion, or reduced water quality.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to the sprinkler irrigation system through which water is distributed by means of sprinklers or spray nozzles. It applies to all components of the onfarm system except for special structures such as permanently installed mains and laterals (See NRCS Conservation Practice Standards *Irrigation Pipeline (Code 430)* and *Pumping Plant for Water Control (Code 533)*. It does not include NRCS Conservation Practice Standard *Irrigation System, Microirrigation (Code 441).*

Sprinkler irrigation plans shall be based on an evaluation of the site and the expected operating conditions. The soils and topography shall be suitable for irrigation for the proposed crops.

Enough good-quality water must be available for practical irrigation of the crops to be grown.

The sprinkler method of water application is suited to most crops, to most irrigable lands, and to most climatic conditions where irrigated agriculture is feasible.

CRITERIA

Depth of Application: The net depth of application shall be based on the available moisture capacity of the soil in the root zone of the crop irrigated or a lesser amount consistent with the landuser's operation plan. The gross depth shall be determined by using field application efficiencies consistent with the conservation of water resources.

Capacity: In regularly irrigated areas, sprinkler irrigation systems shall have either (1) a design capacity adequate to meet the moisture demands of all crops to be irrigated in the design area or (2) enough capacity to meet the requirements of several selected irrigations during critical crop growth periods when less than full irrigation is planned. In computing capacity requirements, allowance must be made for reasonable water losses during application periods.

Systems for special-purpose irrigation shall have the capacity to apply a stated amount of water to the design area in a specified net operating period.

Design Application Rate: The design rate of application shall be within a range established by the minimum practical application rate under local climatic conditions and the maximum rate consistent with the intake rate of the soil and the conservation practices used on the land. If two or more sets of conditions are in the design area, the lowest maximum application rate for areas of significant size shall apply.

Distribution Patterns and Spacing Requirements: A combination of sprinkler spacing, nozzle sizes, and operating pressure that most nearly provides the design application rate and distribution shall be selected. The velocity of prevailing winds and other conditions must be considered.

If available from the manufacturers, uniformity coefficient data shall be used in selecting sprinkler spacing, nozzle sizes, and operating pressure. The uniformity coefficient shall be not less than as shown below:

70% for orchards
75% for deep-rooted (4 feet or more) field and forage crops
85% for high-value or shallow-rooted crops and for any crop where fertilizer or pesticides are applied through the system.

In the absence of such data, sprinkler performance tables provided by the manufacturers shall be used in selecting nozzle sizes, operating pressure, and wetted diameter for the required sprinkler discharge. The maximum spacing shall comply with the following criteria:

1. For low-, intermediate-, and moderate-pressure sprinklers, the spacing along lateral lines (S_1) shall not exceed 50 percent of the wetted diameter, as given in the manufacturer's performance tables, when the sprinkler is operating during optimum pressure. The spacing of laterals along the main line (S_m) shall not exceed 65 percent of this wetted diameter. If winds that can affect the distribution pattern are likely, spacing (S_m) shall be reduced to 60 percent for average velocities of 5 mi/h, to 50 percent for average velocities of 10 mi/h, and to 30 percent for average velocities greater than 10 mi/h.

2. For high-pressure sprinklers and for the giant hydraulic type, the maximum distance (diagonal) between two sprinklers on adjacent lateral lines shall not exceed two-thirds of the wetted diameter under favorable operating conditions. If winds that can affect the distribution pattern are likely, the diagonal spacing shall be reduced to 50 percent of the wetted diameter for average velocities of 5 mi/h and to 30 percent for average velocities greater than 10 mi/h.

3. For perforated pipelines, the spacing recommendations of the manufacturer for the design application rate, number and size of perforations, and operating pressure shall be followed.

Lateral Lines

Lateral lines shall be so designed that the total pressure variation at the sprinkler heads, resulting from friction head and static head, does not exceed 20 percent of the design operating pressure of the sprinklers.

Except for undertree operation, riser pipes used in lateral lines shall be long enough to prevent interference with the distribution pattern when the tallest crop is irrigated. Riser Lengths shall not be less than shown below:

Sprinkler Discharge *(gal/min)*	Riser Length *(in.)*
Less than 10	6
10-25	9
25-50	12
50-120	18
More than 120	36

Main Lines: The design of main lines, submains, and supply lines shall ensure that the quantities of water required are conveyed to all lateral lines at the maximum required pressure.

If the pressure required for sprinkler system operation is provided by pumping, main line pipe sizes shall ensure that there is an economical balance between the capitalized cost of the pipe and annual pumping costs.

PUMP AND POWER UNIT

The pump capacity and the power unit shall be adequate to operate the sprinkler system efficiently when maximum capacity is being pumped against maximum total dynamic head.

CONSIDERATIONS

Consider the effects on the water budget, especially the volume and rate of runoff,

infiltration, evaporation, transpiration, deep percolation, and groundwater recharge.

Potential for changes in plant growth and transpiration because of changes in the volume of soil water should be considered.

Effects on downstream flows or aquifer that would affect other water uses or users should be assessed.

The effect on the water table of the field in providing suitable rooting depth for anticipated land uses should be considered.

Potential ability to manage irrigation water through control of water in the root zone should be assessed.

Effects on erosion and the movement of sediment, and soluble and sediment-attached substances carried by runoff should be considered.

Consider the effects of nutrients and pesticides on surface and groundwater quality.

Potentail effects on the movement of dissolved substances below the root zone or to groundwater should be assessed.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing irrigation sprinkler systems shall be in keeping with this standard and shall describe the requirements for properly installing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An operation and maintenance plan must be prepared for use by the owner or others responsible for operating the system. The plan should provide specific instructions for operating and maintaining the system to ensure that it functions properly. It should also provide for periodic inspections and prompt repair or replacement of damaged components.

REFERENCES

1. NRCS, Field Office Technical Guide (FOTG).

2. Engineering Field Handbook, Chapter 15, Irrigation.